What role can education play in integrated care? Lessons from the ECHO (Extensions for Community Health Outcomes) Concussion program

Received 31 January 2022
Revised 17 May 2022
Accepted 14 June 2022

Q. Jane Zhao
Toronto Rehabilitation Institute, University Health Network, Toronto, Canada
Nathan Cupido
The Wilson Centre, University Health Network and Temerty Faculty of Medicine, Toronto, Canada and
Dalla Lana School of Public Health, Institute of Health Policy, Management and Evaluation, University of Toronto, Toronto, Canada
Cynthia R. Whitehead
The Wilson Centre, University Health Network and Temerty Faculty of Medicine, Toronto, Canada;
Department of Family and Community Medicine, Temerty Faculty of Medicine, University of Toronto, Toronto, Canada and
Women's College Hospital, Toronto, Canada, and
Maria Mylopoulos
The Wilson Centre, University Health Network and Temerty Faculty of Medicine, Toronto, Canada and
Department of Pediatrics, Temerty Faculty of Medicine, University of Toronto, Toronto, Canada

Abstract

Purpose – Design, implementation, and evaluation are all important for integrated care. However, they miss one critical factor: education. The authors define "integrated care education" as meaningful learning that purposefully supports collaboration and the development of adaptive expertise in integrated care. The ECHO (Extensions for Community Health Outcomes) model is a novel digital health solution that uses technology-enabled learning (TEL) to facilitate, support, and model integrated care education. Using ECHO Concussion as

The authors would like to thank the past and current participants of ECHO Concussion. The authors would also like to acknowledge the ECHO staff and hub team.

Research funding: No direct funding was provided for this project; base funding for the ECHO Concussion program came from the Ontario Ministry of Health. Cynthia Whitehead holds the BMO Financial Group Chair in Health Professions Research at UHN.

Journal of Integrated Care
Vol. 30 No. 4, 2022
pp. 373-385
Emerald Publishing Limited
1476-9018
DOI 10.1108/JICA-01-2022-0012

a case study, the authors describe the effects of technology-enabled integrated care education on the micro-, meso-, and macro-dimensions of integrated care.

Design/methodology/approach – This case study was constructed using data extracted from ECHO Concussion from video-archived sessions, participant observation, and internal program evaluation memos. The research team met regularly to discuss the development of relevant themes to the dimensions of integrated care.

Findings – On the micro-level, clinical integration occurs through case-based learning and the development of adaptive expertise. On the meso-level, professional integration is achieved through the development of the "specialist generalist," professional networks and empathy. Finally, on the macro-level, ECHO Concussion and the ECHO model achieve vertical and horizontal system integration in the delivery of integrated care. Vertical integration is achieved through ECHO by educating and connecting providers across sectors from primary to quaternary levels of care. Horizontal integration is achieved through the establishment of lateral peer-based networks across sectors as a result of participation in ECHO sessions with a focus on population-level health.

Originality/value – This case study examines the role of education in the delivery of integrated care through one program, ECHO Concussion. Using the three dimensions of integrated care on the micro-, meso-, and macro-levels, this case study is the first explicit operationalization of ECHO as a means of delivering integrated care education and supporting integrated care delivery.

Keywords Medical education, Healthcare workforce education, Integrated care, ECHO model, Primary care, Adaptive expertise

Paper type Case study

Introduction

Integrated care describes a vision to address fragmented care within and across health and social services (Goodwin *et al.*, 2017; Stange, 2009). This concept is internationally adopted to promote health equity, enhance quality of care, and increase perceived patient satisfaction (Grone and Garcia-Barbero, 2001; Valentijn *et al.*, 2013). Though there are over 175 overlapping and interrelated definitions and concepts (Armitage *et al.*, 2009), one seminal definition by Leutz is "the search to connect the healthcare system [. . .] with other human service systems (e.g. long-term care, education and vocational and housing services) to improve outcomes" (Leutz, 1999). Valentijn *et al.* build upon this definition to operationalize three dimensions in which integrated care takes place: micro-level (clinical integration), meso-level (professional and organizational integration), and macro-level (system integration) (Valentijn *et al.*, 2013).

Recent years have seen a growth of interest in integrated care (Baxter *et al.*, 2018), especially in the area of health system reform (World Health Organization, 2016; Shaw *et al.*, 2011; Ahgren and Axelsson, 2011). This growing interest can be attributed to several factors: on the demand side, an ageing population with increasing chronic illness and multimorbidity (Pefoyo *et al.*, 2015; Rowe *et al.*, 2016) results in social cohesion and a strong public desire for better integrated care (Canadian Medical Association, 2013). On the supply side, new service delivery models (Minkman *et al.*, 2009; Chen *et al.*, 2013), new frameworks (Barr *et al.*, 2003; Valentijn *et al.*, 2013), increased evaluation sophistication (Busetto *et al.*, 2016; Steele Gray and Shaw, 2019), and advances in digital health and information technology (Steele Gray, 2021) have all led to the increasing impact of integrated care.

Design, implementation, and evaluation are all important in advancing the goals of integrated care. However, they miss one critical factor: education. We define "integrated care education" as meaningful learning that purposefully supports collaboration and the development of adaptive expertise in integrated care (Mylopoulos *et al.*, 2018a; Sockalingam *et al.*, 2016). Adaptive expertise is a framework of expert performance and development that emphasises a balance between efficiency (applying known solutions in routine situations) complemented by innovation (generating new solutions in novel situations). It is an increasingly resonant construct in health professions education as the need to train future experts to handle both routine challenges as well as novel, ambiguous and complex situations has become increasingly apparent. Importantly, adaptive expertise is thought to be the

product of learning experiences that support development of both procedural knowledge (knowing what to do) alongside conceptual understanding (know why you're doing it). While traditional approaches to education have frequently focused on developing and assessing procedural knowledge, it is conceptual understanding that prepares clinicians to develop new solutions that meet the needs of patients when known solutions do not apply. As such, integrated care education aligned with the development of adaptive expertise is distinct from training that emphasizes the routine application of algorithms or pathways. Instead training would leverage pedagogies that emphasize development of conceptual understanding in a given clinical domain and thus support providers in the provision of collaborative and sustainable integrated care that can be adapted to serve diverse patients across diverse contexts.

The ECHO (Extensions for Community Health Outcomes) model is a novel digital health solution that uses technology-enabled learning (TEL) to facilitate, support, and model integrated care education (Ertmer and Ottenbreit-Leftwich, 2013). Within ECHO, TEL is used to deliver and support the pedagogies of collaborative learning and adaptive expertise through real-time videoconferencing, ability to attend to nuance and complexity in content and behaviour, as well as decreasing barriers to access by allowing providers to gain education and support, regardless of where they live (Mylopoulos *et al.*, 2018b; Sockalingam *et al.*, 2021; McBain *et al.*, 2019). More broadly within health professions education, virtual learning environments and TEL models have been implemented demonstrating strong benefits for distance learners, potential cost savings, and better or as good care provided to patients – factors which became even more pertinent during the COVID-19 pandemic (Butina *et al.*, 2013; Kyaw *et al.*, 2019; Ewing and Cooper, 2021). Using ECHO Concussion as a case study, we describe the effects of technology-enabled integrated care education on the micro, meso, and macro dimensions of integrated care.

ECHO concussion: a model for integrated care education

The ECHO model is a TEL model whose aim is to enable rapid knowledge exchange and build capacity in primary care. Using a one-to-many model, specialist experts at an academic "hub" connect with multiple learners at sites across a region in real-time through a teleconferencing platform (Arora *et al.*, 2010; Furlan *et al.*, 2019). There are four essential features of the ECHO model: 1) use digital and telehealth technology to leverage scarce healthcare resources, 2) share best practices, 3) use case-based learning to develop speciality training in primary care, and 4) monitor and evaluate outcomes (Dubin *et al.*, 2015). The use of digital and TEL was instrumental in addressing fundamental disparities in access to care education. Though there are similar healthcare models that use telemedicine, most notably eConsult and the Telemedicine IMPACT Plus (TIP) programs, these programs mainly focus on improved provision of care to individual patients and increased knowledge and support to individual clinicians (Liddy *et al.*, 2017; Pariser *et al.*, 2019). In the ECHO model, learning occurs between the whole group of participants and interprofessional education is modelled more widely, fostering strong communities of practice that is not observed in other models. Entrenched hierarchy within the field of medicine remains a challenge that potentially undermines the "all teach, all learn" principle of the ECHO model. At an individual level, ECHO participants have articulated that "It was nerve-wracking at first because we're presenting to experts and I'm just a lowly nurse practitioner in my little clinic" (Carlin *et al.*, 2018). More broadly, ECHO programs continue to preferentially target physicians and nurse practitioners, potentially leaving other healthcare providers somewhat marginalized within program structures.

In 2003, Dr. Sanjeev Arora, a hepatologist in Albuquerque New Mexico, started the first ECHO program to bridge the gap between specialist knowledge and primary care management of hepatitis C virus (Arora *et al.*, 2011, 2016). He recognized the versatility of

the ECHO model to adapt for other common, chronic, and complex conditions in primary care and began to launch more ECHO programs. He also developed a "train-the-trainer" model whereby established ECHO programs ("Superhubs") help support and launch new ECHO programs (The ECHO Institute, 2022). There are currently 658 ECHO programs in 187 countries worldwide (The ECHO Institute, 2021).

The ECHO Concussion program began in Ontario, Canada in 2019 alongside other existing ECHO at University Health Network (UHN) programs in chronic pain, liver, and rheumatology. The aim of ECHO Concussion is to teach learners a comprehensive approach to concussion diagnosis and symptom management across the continuum. Mild traumatic brain injury or concussion is an injury caused by direct impact to the head, often resulting in headache, dizziness, and mood changes (McCrea *et al.*, 2009; Carroll *et al.*, 2014). Rates of concussion are estimated to be 493–653 per 100,000 in Ontario, Canada annually (Langer *et al.*, 2020). Some evidence points to urban/rural disparities with higher rates of concussion and worse outcomes following concussion in rural populations (Yue *et al.*, 2020). Due to the complex nature of concussion management (variable onset presentation and diagnosis, the prevalence of concussion occurrence in sports, and the number of healthcare and non-healthcare professionals involved in case management), there often occurs a lack of communication and continuity between professionals, thus necessitating the need for integrated care in concussion management (Linder *et al.*, 2019). Deficiencies were identified among Canadian medical school regarding concussion education and some policies and initiatives were started to tackle this lack of education (Burke *et al.*, 2012; Hachem *et al.*, 2016). Little evidence, however, has been published to date in this area, especially focusing on education in primary care. ECHO Concussion was developed with these aims of improving concussion care and management across sectors in the province of Ontario, Canada.

In ECHO Concussion live weekly videoconference sessions, there is a didactic component followed by a patient case presentation component. The didactic lectures follow a set curriculum, built around modules developed by content and education experts. The modules include the diagnosis and management of concussion in adult populations, prolonged symptoms in adults, and diagnosis and management in paediatric populations. The patient case is presented by a learner in the community, who summarizes the patient's relevant demographic, medical, psychiatric, and symptom details. The case presenter is also given an opportunity to ask diagnosis or management questions to the group. The following discussion is facilitated around clarifying questions and recommendations are generated from the community learners and expert hub members together.

The pedagogy of adaptive expertise suggests that learners benefit from "productive struggle" and emphasis on the "whys" (integration of basic and clinical science) and "what-ifs" (variation in clinical presentations) in relation to the concepts being taught through didactic lecture as well as the specific patient case discussed (Mylopoulos *et al.*, 2018a). The expert hub team uses technology to enable this type of struggle, integration, and variation by encouraging learners to struggle collectively through a case, each providing a perspective based on their own context, experience, and knowledge. Notably, while medical education has often focused on the traditional basic sciences to explain "why" clinical signs and symptoms occur, within integrated care and ECHO specifically, effective integration of basic and clinical science includes any form of knowledge that can help provide mechanistic understanding of a patient case (Chaudhary *et al.*, 2019). For example, while pathophysiology and etiology are traditionally identified mechanisms for clinical signs and symptoms, behavioural and sociological sciences can often provide additional meaningful mechanisms for patient presentations.

The ECHO Concussion expert hub team includes healthcare providers across nine health disciplines: chiropractic, clinical psychology, family medicine, neurology, neuropsychology, occupational therapy, paediatric medicine, physiatry, and physiotherapy. The ECHO Concussion learners are practicing providers, including physicians, nursing professionals,

physiotherapists, occupational therapists, chiropractors, and other allied health professionals. See Table 1 for a summary of ECHO Concussion program impact. By providing access to a community of concussion experts, the ECHO Concussion program trains frontline providers on up-to-date best practices regarding the diagnosis and management of concussions in adults and youth. The following sections will describe further the impact of ECHO Concussion on the micro-, meso-, and macro-levels of integrated care.

This project was approved by the UHN Quality Improvement Research Committee (QI ID #21–0257). The nature of this project was to explore the ways in which the ECHO Concussion program supports the development of expertise in primary care and how education may play an integral role in program success.

Clinical integration: alignments of the ECHO concussion program and integrated care on the micro-level

The most tangible and direct alignment of ECHO Concussion is on the micro-level of integrated care, clinical integration, which is defined as "a person-focused perspective to improve someone's overall well-being and not focus solely on a particular condition " (Valentijn *et al.*, 2013). The ECHO Concussion patient case presentations, which focus learning and discussion around one patient case, exemplify this dimension of integrated care (Table 2). Even though the inciting and central diagnosis of a patient who is presented may be concussion, the ensuing conversation is never solely about that; instead, care and management is person-centred and broader to include psychosocial health, pharmacological management, non-pharmacological modalities, and additional referral pathways. This discussion is then condensed into a list of recommendations given back to the presenter for further investigations and management options. Throughout the facilitated discussion, the hub team provides feedback, highlights important concussion management or diagnosis principles, and focuses on posing and answering "why" and "what-if" questions. In this way, clinical integration is enhanced as learners move through productive struggle and beyond a single "solution." Instead, they collectively develop a nuanced understanding of patients, providers, and their contexts that could not be achieved in a single place or discipline.

Because ECHO learners attend not only from the field of medicine but also nursing, pharmacy, occupational therapy, physical therapy, and other allied health disciplines, they become exposed to other professional knowledge they may not have immediate access to in their own clinic or within their own discipline. In turn, service integration and care coordination across disciplines become easier for these learners, whose deep understanding of other professions informs their practice. This type of technology-enabled collaborative learning may be most useful when applied to the implementation and experience of integrated care models, which begin on the grounds of complexity.

	Count or percentage
# of sessions	43
# of patient cases discussed	59
# of participants	307
% of participants practicing in rural region*	4.7
Average # of participants/session	49.3
Average # of sessions attended/participant	7.0

Note(s): * In the province of Ontario, one proxy for geographic location is measured by the Rurality Index of Ontario (RIO) score. This is a score based on postal code and census data that ranges from 0 to 100 where 40 and above indicate a rural region

Table 1. ECHO concussion program impact (november 2019 to june 2021)

Integrated care level	Integrated care definition	ECHO concussion program examples
Micro-level	"a person-focused perspective to improve someone's overall well-being and not focus solely on a particular condition"	• Case-based learning via patient case discussions • Development of adaptive expertise
Meso-level	*Professional integration*: "interprofessional partnerships based on shared competences, roles, responsibilities, and accountability to deliver a comprehensive continuum of care to a defined population" *Organizational integration*: the extent that services are produced and delivered in a linked-up fashion	• Development of the "specialist generalist" and stronger interprofessional networks within their own clinics(organizational) • Development of professional networks between clinics (professional) • Development of empathy (professional)
Macro-level	The approach to "enhance efficiency, quality of care, quality of life, and consumer satisfaction" through vertical integration (integration of care across sectors) and horizontal integration (focus on population-health through lateral peer-based networks across sectors)	• Education of providers across sectors, from primary through to quaternary levels of care • Establishment of lateral peer-based networks across sectors as a result of participation in ECHO sessions with a focus on population-level health

Table 2.
ECHO concussion program alignments with integrated care

Professional and organizational integration: alignments of the ECHO concussion program and integrated care on the meso-level

Another direct alignment of ECHO Concussion is on professional and organizational integration. Professional integration focuses on the "interprofessional partnerships based on shared competences, roles, responsibilities, and accountability to deliver a comprehensive continuum of care to a defined population," both within and between organizations, while organizational integration refers to "the extent that services are produced and delivered in a linked-up fashion" (Valentijn *et al.*, 2013). Acknowledging the potential for numerous professionals to be involved in the care of a single concussion patient, the dimension of professional integration promotes the coordination of care and shared responsibility amongst professionals to improve patient outcomes (Delnoij *et al.*, 2002; Kodner, 2009; Shaw *et al.*, 2011). ECHO Concussion facilitates professional and organizational integration in three different ways: 1) within organizations, learners become a "specialist generalist" and build stronger interprofessional networks in their own clinics, 2) between organizations, learners develop professional networks and foster communities of practice, and 3) between professions, learners develop a sense of empathy, thus enabling improved professional integration both within and between organizations.

While the ECHO model was originally targeted to physician and nurse practitioner providers, its interprofessional education model also enhances the expertise of other providers. In a medical and physician-dominated field, ECHO Concussion offers space where physical therapists, nurse practitioners, chiropractors, and other healthcare providers can share and discuss patients they have been struggling with. It's been suggested that this form of collaborative "productive struggle," when collaboration is understood to be a core competency of effective patient care (rather than a professional or organizational imperative), might create the conditions for learning "why" collaboration is important for clinical expertise (Martimianakis *et al.*, 2020). Because the entire care team is unlikely to attend ECHO sessions simultaneously, one provider on a team usually becomes the designated participant to attend ECHO. Thus, while they are developing their expertise in concussion care, more broadly these learners are developing their expertise as "specialist generalists", able to support care for a

wide range of patients in primary care settings (Woods *et al.*, 2021). Learners disseminate ECHO-specific knowledge in didactic lectures and clinical pearls to their colleagues. The ECHO model therefore enables learners to practice at an enhanced scope of practice and build stronger interprofessional networks within their own clinics, which supports organizational integration.

ECHO Concussion learners attend from a diverse range of health professions as well as clinic types. Relationships are formed between organizations from learners to the expert hub team and between learners themselves. The ECHO Concussion expert hub team is based at an academic centre within tertiary care in a large urban city. Most of the learners who attend, however, practice in primary and secondary care clinics across the province of Ontario, a geographic area nearly as big as the country of Bolivia (1,076,000 km^2). They participate from a variety of locations, including Northern and rural areas, where the population is predominantly Indigenous, to underserviced areas in Southern Ontario. By holding space for TEL week after week, ECHO Concussion fosters a strong community of practice, similar to other ECHO programs (Carlin *et al.*, 2018; Zhao *et al.*, 2020). It is within this community of practice that strategic networks between clinics for concussion care may be formed: a family doctor in an urban centre with a patient in a rural area can now refer their patient to another "ECHO-trained" learner in their patient's local area. Thus, this patient can receive high quality concussion care, closer to their home. Finally, another benefit of productive struggle around a patient case within ECHO is the development of empathy between learners. Many learners comment how they have increased awareness of the roles and responsibilities within their own profession and the scope of practice of others. This recognition fosters a strong sense of empathy between professions, a critical element which facilitates interprofessional collaboration and teamwork (Adamson *et al.*, 2018; Ratka, 2018; Fenn *et al.*, 2021) and enables the success of professional integration.

System integration: alignments of the ECHO education model and integrated care on the macro-level

At the macro-level, ECHO Concussion as a program and the ECHO model more generally are both approaches to achieve system integration of integrated care. System integration is defined as the approach to "enhance efficiency, quality of care, quality of life, and consumer satisfaction" (Valentijn *et al.*, 2013). Vertical integration and horizontal integration are both important in this dimension, as the former refers to the integration of care across sectors (ie. across primary, secondary, tertiary, and quaternary levels of care) and the latter refers to a focus on population-level health through lateral peer-based networks across primary care and public health. The ECHO model and its global uptake demonstrates a possibility for system integration more broadly through the development of a more competent and resilient workforce.

ECHO Concussion is a TEL program that achieves vertical integration across sectors by creating supportive communities of practice with learners and hub members from primary care through to quaternary care. Furthermore, ECHO Concussion addresses wider provincial inequities in access to concussion education by connecting learners from Northern and remote regions of the province, where there is a higher prevalence of concussion due to falls and intimate partner violence (Hunt *et al.*, 2018; Wuerch *et al.*, 2019). Thus, by educating providers in high-need areas, ECHO Concussion may contribute to further horizontal integration by increasing equitable access and expanding provincial peer-based networks.

Beyond individual-level changes in confidence, knowledge, or isolation, the ECHO model promotes an ethos of care based on openness and compassion, shifting perceptions regarding medical and continuing professional development education by offering TEL in this way. These align with the "values" of integrated care, where transparent, empowering, and

respectful have been identified (Zonneveld *et al.*, 2018, 2020). Indeed, many features from the ECHO Concussion program that have been described thus far align and overlap with the values of integrated care. The ECHO model and models of integrated care developed separately, but there may be a space moving forward where both support and advance the goals of one another, ultimately advancing integrated care education. And while the ECHO movement alone will not lead to health systems transformation, the eagerness with which the ECHO model is being taken up by individuals and organizations suggests that it may be an effective way to promote such change. In the United States, the ECHO model has been adopted into national policy to address extant healthcare inequities (The ECHO Act, 2016). On a global scale, the ECHO movement has similar potential to build capacity and enhance system efficiency.

Discussion

Integrated care offers a compelling vision for health system improvement. The integrated care literature focuses primarily on design, implementation, and evaluation of integrated care, but little attention is paid to education for integrated care. Despite the aligned goals of integrated care and the ECHO model, this case study is the first explicit operationalization of ECHO as a means of delivering integrated care education and supporting integrated care delivery.

The ECHO model is a TEL model with tremendous potential to deliver and support integrated care education. ECHO Concussion serves as a case study to examine more closely the effects of TEL integrated care education on the micro-, meso-, and macro-levels of integrated care. On the micro-level, clinical integration through case-based discussion and the development of adaptive expertise demonstrates how ECHO Concussion enhances collaborative learning around one patient case. On the meso-level, professional integration within and between organizations is demonstrated through the development of professional networks between clinics and the development of empathy between professions. Also on the meso-level, organizational integration is developed through the establishment of the "specialist generalist" and stronger interprofessional networks within the learner's own clinic. Finally, on the macro-level, ECHO Concussion achieves vertical system integration and the ECHO model and its global uptake demonstrates an opportunity to enhance the delivery of integrated care.

The role of education is only just beginning to be explored in the field of integrated care (Stein, 2021; Barraclough *et al.*, 2021). While many countries around the world are implementing integrated care as part of larger health system reform, education and the training of the healthcare workforce cannot be overlooked. In a perspective paper and one of the first publications to describe education for integrated care, Stein emphasizes the need to "design continuous learning programmes geared to the enhancement of the knowledge, skills and attitudes necessary for integrated care to work on all levels" (Stein, 2016). More recent work advancing the field of integrated care argues for the rethinking of integrated care as heterogeneous, dynamic, and complex (Hughes *et al.*, 2020). Integrated care education, as outlined through examples from ECHO Concussion reveal how the ECHO model may fit this rethinking of integrated care: 1) through the development of adaptive expertise, and 2) the development of interprofessional empathy. As demonstrated through Valentijn's integrated care framework, there are multiple levels on which integrated care operates, which, by nature, is complex. Using ECHO Concussion as a case study, we observe how learners develop adaptive expertise, balancing both the routine and the novel. It is this approach to education where emphasis and repeated supportive demonstration of conceptual knowledge through patient case presentations that allows ECHO to be dynamic and complex. Finally, when individual learners gain insight into other professions' roles and responsibilities in medical care and disease management, this facilitates heterogeneity in approaches to integrated care.

At a system level, the ECHO model quietly subverts some of the established hierarchies in medical practice through its inclusive practices. Within ECHO Concussion, there is clear evidence of value for more diverse providers, who might benefit from being more explicitly identified as desired participants. That said, whose authority is legitimate and who gets listened to remain interesting tensions which are observed in ECHO Concussion and unsurprisingly replicate existing healthcare hierarchies. At an individual level, learners still articulate fear of judgement and wanting to present a "good" patient case. Hierarchies are also visible beyond individual levels of interaction, as this ECHO program focuses on physicians and nurse practitioners. Yet within ECHO Concussion, there is also clear evidence of value for more diverse providers, who might benefit from being more explicitly identified as desired participants. The TEL model may assist in flattening hierarchies in allowing all participants opportunities to speak. Going forward, in addition to ensuring that the educational model is inclusive, future research could explore the ways in which learners are enabled or constrained in terms of bringing new knowledge back into existing healthcare hierarchies or monitor for shifts towards more equitable and effective care models as a result of ECHO programs.

There are several limitations of this case study. There is limited generalizability of findings to other ECHO or TEL programs, as ECHO Concussion is a unique program not replicated elsewhere in the world. There may be outcomes that are ECHO Concussion-specific. It is also posited that ECHO Concussion learners develop adaptive expertise and practice with enhanced scopes of care. However, little research has been conducted to investigate the longer-term sustainability of program changes on practice. Finally, ECHO operates embedded as a part of larger health systems. These systems have long-standing challenges with data linkage and infrastructure that one individual program cannot address. Though these issues are beyond the scope of ECHO Concussion, they greatly affect the degree to which learners may be receptive to and adopt change. It is clear that more research is needed at the intersection of education and integrated care: which aspects of which education models best facilitate sustainable change in which levels of integrated care? And how may an un-siloed education approach to integrated care like ECHO be different than education of individual professions separately?

Conclusion

Everyone deserves high quality care regardless of where they live. Integrated care provides an opportunity to enhance both quality and equity of care. These dimensions are predominantly discussed in the literature with respect to the design, implementation, and evaluation of integrated care; however, we believe that education for integrated care is a critical aspect that is often missed in the integrated care literature. The ECHO model is a digital health solution that uses TEL to facilitate, support, and model integrated care education. Using ECHO Concussion as a case study, we describe the effects of technology-enabled integrated care education on the micro-, meso-, and macro-dimensions of integrated care. The ECHO model has the potential to promote collaboration and the development of adaptive expertise in learners, to build stronger interprofessional networks and communities of practice and to connect healthcare beyond sectors to address system-level disparities. Given the careful and deliberate planning within ECHO programs for meaningful TEL, the ECHO model might serve as an important tool for the delivery and support of integrated care education.

References

Adamson, K., Loomis, C., Cadell, S. and Verweel, L.C. (2018), "Interprofessional empathy: a four-stage model for a new understanding of teamwork", *Journal of Interprofessional Care*, Vol. 32 No. 6, pp. 752-761.

Ahgren, B. and Axelsson, R. (2011), "A decade of integration and collaboration: the development of integrated health care in Sweden 2000-2010", *The International Journal of Integrated Care*, Vol. 11, pp. 1-8, available at: https://pubmed.ncbi.nlm.nih.gov/21677844/.

Armitage, G.D., Suter, E., Oelke, N.D. and Adair, C.E. (2009), "Health systems integration: state of the evidence", *The International Journal of Integrated Care*, Vol. 9, p. e82.

Arora, S., Kalishman, S., Thornton, K., Dion, D., Murata, G., Deming, P., Parish, B., Brown, J., Komaromy, M., Colleran, K., Bankhurst, A., Katzman, J., Harkins, M., Curet, L., Cosgrove, E. and Pak, W. (2010), "Expanding access to hepatitis C virus treatment–extension for community healthcare outcomes (ECHO) project: disruptive innovation in specialty care", *Hepatology*, Vol. 52 No. 3, pp. 1124-1133.

Arora, S., Thornton, K., Murata, G., Deming, P., Kalishman, S., Dion, D., Parish, B., Burke, T., Pak, W., Dunkelberg, J., Kistin, M., Brown, J., Jenkusky, S., Komaromy, M. and Qualls, C. (2011), "Outcomes of treatment for hepatitis C virus infection by primary care providers", *The New England Journal of Medicine*, Vol. 364 No. 23, pp. 2199-2207.

Arora, S., Kalishman, S., Thornton, K., Komaromy, M., Katzman, J., Struminger, B. and Rayburn, W.F. (2016), "Project ECHO (project extension for community healthcare outcomes): a national and global model for continuing professional development", *Journal of Continuing Education in the Health Professions*, Vol. 36 Suppl 1, pp. S48-S49.

Barr, V.J., Robinson, S., Marin-Link, B., Underhill, L., Dotts, A., Ravensdale, D. and Salivaraset, S. (2003), "The expanded chronic care Model: an integration of concepts and strategies from population health promotion and the Chronic Care Model", *Hospital Quarterly*, Vol. 7 No. 1, pp. 73-82.

Barraclough, F., Smith-Merry, J., Stein, V. and Pit, S. (2021), "Workforce development in integrated care: a scoping review", *International Journal of Integrated Care*, Vol. 21 No. 4, pp. 1-14.

Baxter, S., Johnson, M., Chambers, D., Sutton, A., Goyder, E. and Booth, A. (2018), "The effects of integrated care: a systematic review of UK and international evidence", *BMC Health Services Research*, Vol. 18 No. 1, p. 350.

Burke, M.J., Chundamala, J. and Tator, C.H. (2012), "Deficiencies in concussion education in Canadian medical schools", *Canadian Journal of Neurological Sciences*, Vol. 39, pp. 763-766.

Busetto, L., Luijkx, K. and Vrijhoef, H.J.M. (2016), "Development of the COMIC Model for the comprehensive evaluation of integrated care interventions", *International Journal of Care Coordination*, Vol. 19, pp. 47-58.

Butina, M., Brooks, D., Dominguez, P.J. and Mahonet, G.M. (2013), "Utilization of virtual learning environments in the allied health professions", *Journal of Allied Health Sciences and Practice*, Vol. 42 No. 1, pp. e7-10.

Canadian Medical Association (2013), "Health and health care for an aging population", *Policy Summary of the Canadian Medical Association*, available at: https://cma.ca/sites/default/files/2018-11/CMA_Policy_Health_and_Health_Care_for_an_Aging-Population_PD14-03-e_0.pdf (accessed 20 April 2022).

Carlin, L., Zhao, J., Dubin, R., Taenzer, P., Sidrak, H. and Furlan, A.D. (2018), "Project ECHO telementoring intervention for managing chronic pain in primary care: insights from a qualitative study", *Pain Med*, Vol. 19 No. 6, pp. 1140-1146.

Carroll, L.J., Cassidy, J.D., Cancelliere, C., Côté, P., Hincapié, C.A., Kristman, V.L., Holm, L.W., Borg, J., Nygren-de Boussard, C. and Hartvigsen, J. (2014), "Systematic review of the prognosis after mild traumatic brain injury in adults: cognitive, psychiatric, and mortality outcomes: results of the International Collaboration on Mild Traumatic Brain Injury Prognosis", *Archives of Physical Medicine and Rehabilitation*, Vol. 95 3 Suppl, pp. S152-S173.

Chaudhary, Z.K., Mylopoulos, M., Barnett, R., Sockalingam, S., Hawkins, M., O'Brien, J.D. and Woods, N.N. (2019), "Reconsidering basic: integrating social and behavioral sciences to support learning", *Academic Medicine*, Vol. 94 No. 11S, pp. S73-S78.

Chen, A.H., Murphy, E.J. and Yee, H.F., Jr. (2013), "eReferral–a new model for integrated care", *The New England Journal of Medicine*, Vol. 368 No. 26, pp. 2450-2453.

Delnoij, D., Klazinga, N. and Glasgow, I.K. (2002), "Integrated care in an international perspective", *International Journal of Integrated Care*, Vol. 2, p. e04.

Dubin, R.E., Flannery, J., Taenzer, P., Smith, A., Smith, K., Fabico, R., Zhao, J., Cameron, L., Chmelnitsky, D., Williams, R., Carlin, L., Sidrak, H., Arora, S. and Furlan, A.D. (2015), "ECHO Ontario chronic pain and opioid stewardship: providing access and building capacity for primary care providers in underserviced, rural, and remote communities", *Studies in Health Technology and Informatics*, Vol. 209, pp. 15-22.

Ertmer, P.A. and Ottenbreit-Leftwich, A. (2013), "Removing obstacles to the pedagogical changes required by Jonassen's vision of authentic technology-enabled learning", *Computers and Education*, Vol. 64, pp. 175-182.

Ewing, L.-A. and Cooper, H.B. (2021), "Technology-enabled remote learning during Covid-19: perspectives of Australian teachers, students and parents", *Technology, Pedagogy and Education*, Vol. 30, pp. 41-57.

Fenn, N., Reyes, C., Mushkat, Z., Vinacco, K., Jackson, H., Al Sanea, A., Robbins, M.L., Hulme, J. and Dupre, A.M. (2021), "Empathy, better patient care, and how interprofessional education can help", *Journal of Interprofessional Care*, pp. 1-10, available at: https://pubmed.ncbi.nlm.nih.gov/34382506/.

Furlan, A.D., Zhao, J., Voth, J., Hassan, S., Dubin, R., Stinson, J.N., Jaglal, S., Fabico, R., Smith, A.J., Taenzer, P. and Flannery, J.F. (2019), "Evaluation of an innovative tele-education intervention in chronic pain management for primary care clinicians practicing in underserved areas", *Journal of Telemedicine and Telecare*, Vol. 25 No. 8, pp. 484-492.

Goodwin, N., Stein, V. and Amelung, V. (2017), "What is integrated care?", in Amelung, V., Stein, V., Suter, E., *et al.* (Eds), *Handbook Integrated Care*, 2nd ed., Springer International Publishing, Cham, pp. 3-23.

Grone, O. and Garcia-Barbero, M. (2001), "Integrated care: a position paper of the WHO European office for integrated health care services", *International Journal of Integrated Care*, Vol. 1, p. e21.

Hachem, L.D., Kourtis, G., Mylabathula, S. and Tator, C.H. (2016), "Experience with Canada's first policy on concussion education and management in schools", *Canadian Journal of Neurological Sciences*, Vol. 43 No. 4, pp. 554-560.

Hughes, G., Shaw, S.E. and Greenhalgh, T. (2020), "Rethinking integrated care: a systematic hermeneutic review of the literature on integrated care strategies and concepts", *Milbank Quarterly*, Vol. 98 No. 2, pp. 446-492.

Hunt, C., Michalak, A., Lefkimmiatis, C., Johnston, E., Macumber, L., Jocko, T. and Ouchterlony, D. (2018), "Exploring concussion awareness in hockey with a First Nations community in Canada", *Public Health Nursing*, Vol. 35 No. 3, pp. 202-210.

Kodner, D.L. (2009), "All together now: a conceptual exploration of integrated care", *Healthcare Quarterly*, Vol. 13, Spec Nos: 6-15.

Kyaw, B.M., Saxena, N., Posadzki, P., Vseteckova, J., Nikolaou, C.K., George, P.P., Divakar, U., Masiello, I., Kononowicz, A.A., Zary, N. and Tudor Car, L. (2019), "Virtual reality for health professions education: systematic review and meta-analysis by the digital health education collaboration", *Journal of Medical Internet Research*, Vol. 21 No. 1, p. e12959.

Langer, L., Levy, C. and Bayley, M. (2020), "Increasing incidence of concussion: true epidemic or better recognition?", *Journal of Head Trauma Rehabilitation*, Vol. 35 No. 1, pp. E60-E66.

Leutz, W.N. (1999), "Five laws for integrating medical and social services: lessons from the United States and the United Kingdom", *Milbank Quarterly*, Vol. 77 No. 1, pp. 77-110, iv-v.

Liddy, C., Drosinis, P., Fogel, A. and Keely, E. (2017), "Prevention of delayed referrals through the Champlain BASE eConsult service", *Canadian Family Physician*, Vol. 63 No. 8, pp. e381-e386.

Linder, S.M., Cruickshank, J., Zimmerman, N.M. and Figler, R. (2019), "A technology-enabled electronic incident report to document and facilitate management of sport concussion: a cohort study of youth and young adults", *Medicine (Baltimore)*, Vol. 98 No. 14, p. e14948.

Martimianakis, M.A.T., Fernando, O., Schneider, R., Tse, S. and Mylopoulos, M. (2020), "It's not just about getting along: exploring learning through the discourse and practice of interprofessional collaboration", *Academic Medicine*, Vol. 95 No. 11S, pp. S73-S80.

McBain, R.K., Sousa, J.L., Rose, A.J., Baxi, S.M., Faherty, L.J., Taplin, C., Chappel, A. and Fischer, S.H. (2019), "Impact of project ECHO models of medical tele-education: a systematic review", *Journal of General Internal Medicine*, Vol. 34 No. 12, pp. 2842-2857.

McCrea, M., Iverson, G.L., McAllister, T.W., Hammeke, T.A., Powell, M.R., Barr, W.B. and Kelly, J.P. (2009), "An integrated review of recovery after mild traumatic brain injury (MTBI): implications for clinical management", *The Clinical Neuropsychologist*, Vol. 23 No. 8, pp. 1368-1390.

Minkman, M., Ahaus, K., Fabbricotti, I., Nabitz, U. and Huijsman, R. (2009), "A quality management model for integrated care: results of a Delphi and Concept Mapping study", *International Journal for Quality in Health Care*, Vol. 21 No. 1, pp. 66-75.

Mylopoulos, M., Kulasegaram, K. and Woods, N.N. (2018a), "Developing the experts we need: fostering adaptive expertise through education", *Journal of Evaluation in Clinical Practice*, Vol. 24 No. 3, pp. 674-677.

Mylopoulos, M., Steenhof, N., Kaushal, A., *et al.* (2018b), "Twelve tips for designing curricula that support the development of adaptive expertise", *Medical Teacher*, Vol. 40 No. 8, pp. 850-854.

Pariser, P., Pham, T.T., Brown, J.B., Stewart, M. and Charles, J. (2019), "Connecting people with multimorbidity to interprofessional teams using telemedicine", *Annals of Family Medicine*, Vol. 17 Suppl 1, pp. S57-S62.

Pefoyo, A.J., Bronskill, S.E., Gruneir, A., Calzavara, A., Thavorn, K., Petrosyan, Y., Maxwell, C.J., Bai, Y.Q. and Wodchis, W.P. (2015), "The increasing burden and complexity of multimorbidity", *BMC Public Health*, Vol. 15 No. 10, p. 415.

Ratka, A. (2018), "Empathy and the development of affective skills", *American Journal of Pharmaceutical Education*, Vol. 82 No. 10, p. 7192.

Rowe, J.W., Fulmer, T. and Fried, L. (2016), "Preparing for better health and health care for an aging population", *JAMA*, Vol. 316 No. 16, pp. 1643-1644.

Shaw, S., Rosen, R. and Rumbold, B. (2011), *What Is Integrated Care?*, Nuffield Trust.

Sockalingam, S., Mulsant, B.H. and Mylopoulos, M. (2016), "Beyond integrated care competencies: the imperative for adaptive expertise", *General Hospital Psychiatry*, Vol. 43, pp. 30-31.

Sockalingam, S., Rajaratnam, T., Zhou, C., Serhal, E., Crawford, A. and Mylopoulos, M. (2021), "Building mental health capacity: exploring the role of adaptive expertise in the ECHO virtual learning model", *Journal of Continuing Education in the Health Professions*, Vol. 41 No. 2, pp. 104-110.

Stange, K.C. (2009), "The problem of fragmentation and the need for integrative solutions", *Annals of Family Medicine*, Vol. 7 No. 2, pp. 100-103.

Steele Gray, C. (2021), "Integrated care's new protagonist: the expanding role of digital health", *International Journal of Integrated Care*, Vol. 21 No. 4, p. 1.

Steele Gray, C. and Shaw, J. (2019), "From summative to developmental: incorporating design-thinking into evaluations of complex interventions", *Journal of Integrated Care*, Vol. 27 No. 3, pp. 241-248.

Stein, K.V. (2016), "Developing a competent workforce for integrated health and social care: what does it take?", *International Journal of Integrated Care*, Vol. 16 No. 4, p. 9.

Stein, K.V. (2021), "Towards sustainable change: education and training as a key enabler of integrated care", in Amelung, V., Stein, V., Suter, E., *et al.* (Eds), *Handbook Integrated Care*, Springer International Publishing, Cham, pp. 311-326.

The ECHO Act (2016), *S. 2873 (114th Congress): ECHO Act (2016)*, available at: https://www.govtrack.us/congress/bills/114/s2873 (accessed 18 January 2022).

The ECHO Institute (2021), "Data marketplace", available at: https://hsc.unm.edu/echo/partner-portal/data-marketplace/ (accessed 18 January 2022).

The ECHO Institute (2022), "What is a Superhub?", available at: https://hsc.unm.edu/echo/become-a-partner/superhubs/ (accessed 19 January 2022).

Valentijn, P.P., Schepman, S.M., Opheij, W. and Bruijnzeelset, M.A. (2013), "Understanding integrated care: a comprehensive conceptual framework based on the integrative functions of primary care", *International Journal of Integrated Care*, Vol. 13, p. e010.

Woods, N.N., Mylopoulos, M., Nutik, M. and Freeman, R. (2021), "Defining the specialist generalist: the imperative for adaptive expertise in family medicine", *Canadian Family Physician*, Vol. 67 No. 5, pp. 321-322.

World Health Organization (2016), *Integrated Care Models: An Overview*, Geneva.

Wuerch, M.A., Zorn, K.G., Juschka, D. and Hampton, M.R. (2019), "Responding to intimate partner violence: challenges faced among service providers in northern communities", *Journal of Interpersonal Violence*, Vol. 34 No. 4, pp. 691-711.

Yue, J.K., Upadhyayula, P.S., Avalos, L.N., Phelps, R.R.L., Suen, C.G. and Cage, T.A. (2020), "Concussion and mild-traumatic brain injury in rural settings: epidemiology and specific health care considerations", *Journal of Neurosciences in Rural Practice*, Vol. 11 No. 1, pp. 23-33.

Zhao, J., Salemohamed, N., Stinson, J., Carlin, L.E., Seto, E., Webster, F. and Furlan, A.D. (2020), "Health care providers' experiences and perceptions participating in a chronic pain telementoring education program: a qualitative study", *Canadian Journal of Pain*, Vol. 4 No. 1, pp. 111-121.

Zonneveld, N., Driessen, N., Stussgen, R.A.J. and Minkman, M.M.N. (2018), "Values of integrated care: a systematic review", *International Journal of Integrated Care*, Vol. 18 No. 4, p. 9.

Zonneveld, N., Raab, J. and Minkman, M.M.N. (2020), "Towards a values framework for integrated health services: an international Delphi study", *BMC Health Services Research*, Vol. 20 No. 1, p. 224.

Corresponding author
Q. Jane Zhao can be contacted at: jane.zhao@uhn.ca